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IMPROVEMENT OF THE RX-TYPE REGENERATOR FOR RECOVERING COTTON PARTICLES FROM WASTE SEPARATED DURING RAW COTTON CLEANING

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Abstract

In this research, a rubber-slatted drum is proposed instead of the separating brush drum in the RX-type cotton regenerator in order to reduce brush wear. To increase the duration of cotton-particle cleaning in the RX regenerator, the inclination angles of the slats along the drum axis toward its center were varied. As a result, both the cleaning efficiency and the efficiency of removing cotton from the saw drum were improved.

Keywords: Raw cotton, cotton particle, cleaning, regenerator, brush drum, waste, device, saw cylinder, motion.

Introduction

Cotton fiber is one of the principal raw materials of the global textile industry, with approximately 23–24 million tons of cotton fiber produced worldwide each year. Due to rapid population growth, the consumption of and demand for cotton fiber are expected to increase in the future. Therefore, important tasks worldwide include improving cotton cultivation and its consumer properties; identifying and eliminating factors that adversely affect product quality during cotton preparation and primary processing, particularly harvesting, transportation, drying, and cleaning from impurities; and developing automated, resource-efficient



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technologies that reduce production costs. International practice shows that the processing of raw cotton produces, in addition to cotton fiber, seed and lint, a considerable amount of fibrous waste of several fractions. In this field, various studies are being conducted and implemented under industrial conditions to prevent different impurities remaining in seeds sent for linting from entering the lint and increasing its impurity content. Particular attention is currently being paid to the development of resource-efficient, automated equipment for removing impurities from cotton and seed, and to the broad introduction of simple cleaning equipment and technologies in order to improve the consumer properties of cotton products.

Comprehensive measures are being implemented in our country to produce high-quality fiber and lint from domestically grown raw cotton and, through deep processing, to manufacture a wide range of high-quality, low-cost textile and light-industry products and improve their competitiveness. At the current stage of development of the cotton-cleaning industry, the technical and technological measures being introduced must ensure timely primary processing of harvested raw cotton without losses, while preserving its natural properties to the greatest possible extent, and uninterrupted delivery of the resulting products to consumers. Initially, after cotton was cleaned in separately installed cleaners, it was conveyed to the gin by intermediate transport equipment. Considering that 20–25% of the technological costs of primary cotton processing were attributable to intermediate transportation, research was carried out to eliminate intermediate transport equipment and thereby reduce operating costs.

For machine-picked and difficult-to-clean cotton, the number of sections in the UXK cleaning unit was increased to six, and 1XK cleaners for removing fine impurities from cotton were installed at the inlet and outlet of the unit. Unlike the CHX-type cleaner, the UXK unit has a capacity of 7 t/h, while its cleaning



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efficiency is 75–80%, depending on cotton moisture content and initial contamination.

At present, waste of various forms and conditions is separated after UXK cleaning units at cotton-cleaning enterprises [1], and this waste contains a certain amount of raw-cotton particles. To recover the cotton particles contained in the waste, regeneration is required after the cleaning process; this function is performed by an RX-type regenerator. This device is used to clean raw cotton from various fine impurities and weed residues [2].

These existing devices consist of a pneumatic feeder, a cleaning module located beneath it, and waste screws. Their principal disadvantages are low productivity and low cleaning efficiency with respect to fibrous material [3–4].

The purpose of the research is to increase cleaning efficiency and the productivity of the device by ensuring timely removal of cotton from the teeth of the saw cylinders. To achieve this goal, an additional outlet pipe was installed; the inlet and outlet pipes were positioned above the saw drum with their axes lying in the same horizontal plane. This makes it possible to use the device in a pneumatic conveying system.

The improved working elements of the proposed cleaner-regenerator (Fig. 1) consist of an upper cover with inlet and outlet pipes (Fig. 1a) and a separating slatted drum (Fig. 1b).

The cleaner-regenerator mainly consists of cover 1, main saw drum 2, regenerating saw drum 3, slatted drum 4, and grate 5 of the main saw drum. The gap between the grate bars is $h = 40$ mm, while the gap between the grate bars forming the regenerating drum grate is $h_1 = 25$ mm. Inlet pipe 7 and outlet pipe 8 are installed horizontally along the axis of the saw drum.



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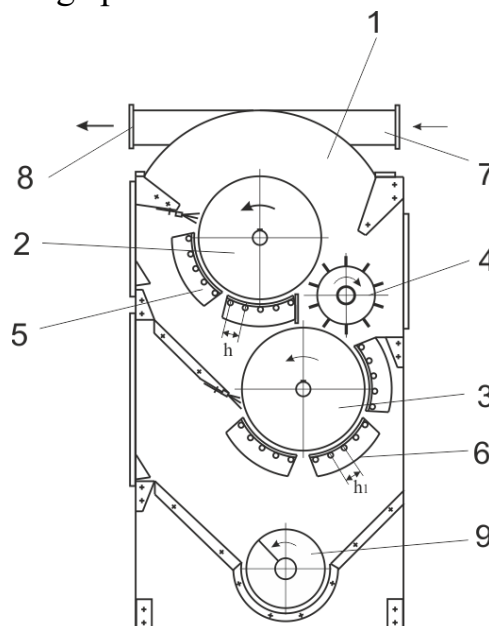
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Raw cotton arriving with an air flow velocity of 2 m/s passes through the receiving pneumatic duct and inlet pipe 7 to the main saw drum 2. It then engages with the teeth of the saw clothing and rubs against the grate having a 40 mm gap. The slats 10 of the slatted drum (Fig. 1b) are generally arranged at an inclination of 15°. Consequently, when the slatted drum rotates, it becomes possible to remove raw cotton simultaneously from both the main saw drum and the regenerating saw drum. In addition, by creating an air flow opposite to the direction of raw-cotton movement, the cotton motion is temporarily retarded, allowing it to undergo cleaning several times and thereby increasing cleaning efficiency.

The cleaned raw cotton is removed by slatted drum 4 and directed to the cylindrical pneumatic feeder. There, under the action of an air flow generated axially through the outlet pipe, the cotton moves to some extent along the axis of drum 2 toward the center of the two-part inlet pipe. The raw cotton then converges before reaching the discharge pneumatic feeder and is discharged through it.





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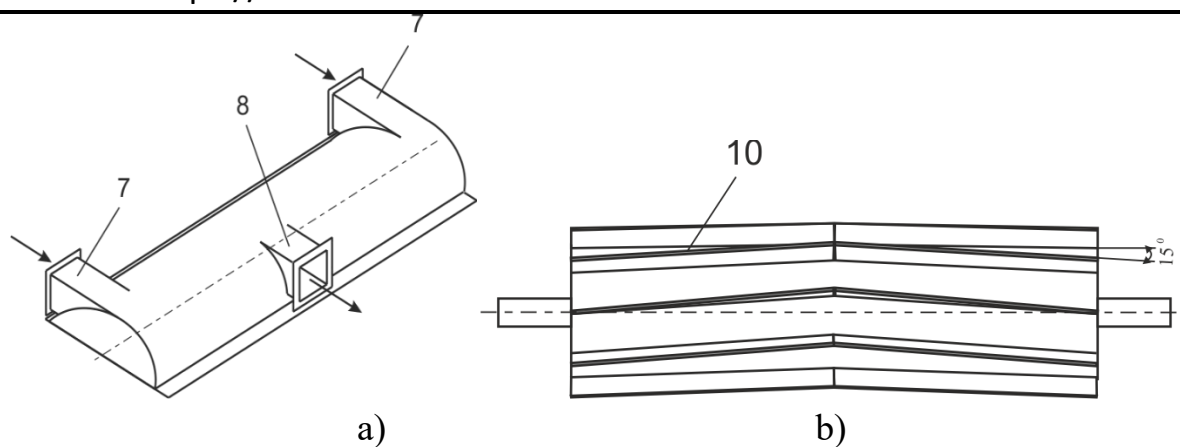


Fig. 1. Schematic diagram of the raw-cotton cleaner-regenerator

a) inlet and outlet pipes; b) slatted drum

1 – cover; 2 – main saw drum; 3 – regenerating saw drum; 4 – slatted drum; 5 – grate of the main saw drum; 6 – regenerating drum grate; 7 – inlet pipe; 8 – outlet pipe; 9 – waste screw; 10 – slats

Impurity mixtures and individual cotton locks pass through grate 5, which has a 40 mm gap, and move from the sliding chute to regenerating saw drum 3 in order to separate the cotton locks. Since the gaps in its grate are 25 mm, the cotton locks are prevented from being carried away together with the separated impurities.

The separated cotton locks are returned by slatted drum 4 to main saw drum 2 for repeated cleaning. The impurity mixture falling through the grate is discharged by waste screw 9. To improve raw-cotton cleaning, the slats of the slatted drum are inclined at 15 degrees, which is expected to increase cleaning efficiency by 1.5 times.



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Conclusion

It was established that improving the design of the new cleaner-regenerator developed in this research can increase the efficiency of recovering cotton particles from impurities by up to 85% without significantly affecting the technological process. At present, work is underway to manufacture the proposed device.

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